International Planthopper Conference

June 23 – 25, 2008
Venue: IRRI

Theme: ***Planthoppers – New threats to the sustainability of intensive rice production systems in Asia***

Conference Synopsis

The rice planthoppers, brown and white back planthoppers (BPH and WBPH) are pests which are normally kept in check by naturally-occurring biological control services. In large populations, the planthoppers can completely destroy crops, a symptom called "hopper burn". In addition, the BPH is a known vector of two persistent virus diseases, the grassy stunt and the ragged stunt. Plants infected by these viruses are stunted and have no yields.

In the 1970s, BPH became a threat to rice intensification programs in Indonesia, Thailand, India, Solomon Islands and the Philippines. IRRI organized the first BPH international conference in 1977 which brought together scientists from all rice producing countries to tackle the problem. Activities triggered by this conference that followed, including IPM, reducing unnecessary insecticide use and breeding resistant varieties that contributed to improved management of the pest that kept it under control for the next 20 years. However in the last 5 years, planthopper problems have intensified in several countries, like China and Vietnam. This might be due of factors such increased fertilizer and pesticide intensities, climate, changes in rice varieties (hybrid rice) and cropping patterns. Growing insecticide resistance especially to imidacloprid, BPMC, fipronil and buprofuzin is also a concern.

The International Conference on Rice Planthoppers brought together 88 scientists, agricultural directors and pesticide company representatives from Australia (1), Bangladesh (2), Cambodia (3), China (4), FAO (3), India (5), Indonesia (2), Japan (7), Korea (3), Laos (2), Malaysia (3), Philippines (13), Singapore (1), Taiwan (1), Thailand (6), USA (2), Vietnam (5) and IRRI (25). Two keynote addresses and 17 scientific papers were presented. On the third day, a panel discussion and a facilitated workshop to brainstorm for solutions was conducted. The Conference program is in Appendix 1.

Opening and keynote addresses

The Conference was opened with a welcome address from the acting director general, Dr William Padolina and a video of the DG Dr Robert Zeigler's welcome speech. In the DG's welcome he challenged the Conference to developed sustainable solutions to the planthopper problems to tackle rice price increases and climate change. The first keynote address was presented by Dr Peter Kenmore, Chief of Plant Protections Services, FAO, Rome. He stressed that planthopper problems are induced by insecticides. Farmers generally respond to cues from the public and private sector that instill their fear of losing their production. In the 1970s and 80s, the BPH was a huge problem in the rice intensification programs of the Philippines and Indonesia as a result of packaged fertilizers and insecticides and in these two countries. The BPH problem in Indonesia has remained minor after significant policy interventions to remove insecticide subsidies and the implementation of IPM. Professor Geoff Gurr, professor of applied ecology in Charles Sturt University, Australia, in his keynote emphasized the role of habitat manipulation and design in agricultural systems in bringing about sustainable pest management and introduced the concepts of ecological engineering. He described the use of shelters, border rows and corridors in enhancing biological control in Australian agriculture and the prospects of using such approaches in rice production.

The scientific papers were presented in three sessions:

Planthopper Problems

Dr Kajisa provided the economic setting for the Conference discussing the current situation in rice market and the lessons we can draw from the past. A similar rice price surge happened in the 1960s and it prompted the Green Revolution. At the same time it also prompted heavy chemical usage and the first threat of the BPH occurred in several Asian countries. Professor Jiaan Cheng discussed about the increasing BPH problems in China and attributed these occurrences to increase in population growth rates, brought about by increases in summer temperatures, cropping intensities, hybrid rice and heavy pesticide use. In 2005, the BPH, which had remained in low densities since the 1980s, caused a series of outbreaks in Vietnam, China, Korea and Japan. The biggest damages were from China, where 7.5 million ha in several provinces were infested resulting in a loss of 2.8 million t of paddy. In Vietnam in addition to BPH damages, crops were severely damaged by viral infections transmitted by BPH. In 2006, the ministry reported a loss of 400,000 t rice, which prompted the government to restrict exports in fear of domestic shortages.

Watanabe et al discussed about the wind borne immigrants from China are the main source of BPH immigrants to Japan, as BPH is unable to over-winter there. Thus all BPH populations are exogenous from Southern China. Development of insecticide resistance by BPH is at an alarming rate and Matsumura et al presented data from Vietnam, China and Japan showing > 800 fold resistance to imidacloprid which was introduced about 10 years ago. One factor they attributed to was the use of imidacloprid seed dressing as a prophylactic which contributed significantly to selection pressure for the BPH to evolve. Since planthoppers cannot over-winter in Japan thus all insecticide resistant BPH are immigrants from China. The main reason for the quick development of insecticide resistance may be due to the heavy use of compounds with similar chemistry over Vietnam, China and Japan. Dr Cabauatan et al presented a whole spectrum of symptoms the two viruses carried by BPH exhibit and called this “yellowing syndrome”. The range of symptoms depends on the relative timing of infections by the rice grassy stunt (RGSV) and the rice ragged stunt (RRSV). Otuka et al developed a model to predict the potential of BPH migration based on weather data. The model available in the web presents the areas in China, Japan and Korea that BPH can potentially move to. Sogawa et al introduced their work on WBPH in Chinese hybrid rice. They found that hybrid rice CMS lines are extremely susceptible to WBPH thus favoring their development. The situation of planthopper problems and current research in several Asian countries were summarized by Catindig et al. The survey showed that the countries where planthoppers are seriously infesting rice are China and Vietnam, where pesticide use is high. Planthopper research in many countries is mainly dominated by screening of varieties, chemical evaluation, laboratory studies and lack of field research. Limited research is done on developing field resistance and ecology. Zhu et al discussed the management of the smaller brown planthopper, another species of planthoppers that occur in temperate rice. This species transmits the black streak virus disease and is beginning to cause production losses in central and northern China.

Host plant resistance (HPR) breeding

In the last 30 years since the first BPH conference in 1977, scientific approaches in genetics, ecology and pest management have advanced considerably. Classical host plant resistance had been IRRI's main approach to BPH management but this may not suffice, as the pest population structures constantly evolve. Meanwhile about 21 BPH resistance genes and several QTLs have been identified by researchers. However all these genes have been screened using the same phenotypic bioassay, the seedbox test. This test seem to have only screened for anti feedant effects that seedling rice have on BPH and that field populations can easily adapt to. Thus varieties carrying genes screened by the seedbox technique might confer resistance at the young crop stages, but this resistance may not hold when the crop is in the field as BPH populations can easily find a small niche to continue feeding to survive. In debating this point there was consensus in the Conference that there is need to develop another phenotypic bioassay that is identifying plant characteristics that affect the insect's ecological fitness. Work by Dr Seo et al in Korea also showed that BPH populations migrating from China have strong resistance breaking abilities using the seedbox test as well as other fitness characters. Chen et al discussed the variability of BPH populations using micro satellite markers and found that there are little differences probably because of the constant insect movements. She also discussed the role symbionts might play in the observed variability and adaptability in planthoppers' host plant-insect relationships. Noda et at described recent developments in insect genomics had facilitated new approaches to elucidate planthopper virulence against resistant rice varieties, pesticide resistance mechanisms, and virus transmission abilities. From expressed sequence tag (EST) analysis in BPH a micro-array can be fabricated.

Management of rice planthoppers

Ecological research showed that BPH is a secondary pest induced by ecological perturbations, particularly insecticides. Heong discussed evidences to show that BPH outbreaks are due to breakdown in ecosystem services, particularly biological control and invasion resistance, thus compromising rice system health and make them vulnerable to pest attacks. If the perturbations are removed, rice ecosystems have the resilience to bounce back. Species richness of predators, parasitoids and detritivores increased significantly in IRRI farm after insecticide use was reduced by > 95% and BPH populations are now extremely low. Another symptom of ecosystem breakdown is the rapid development of insecticide resistance similar to the "crisis and disaster phases" described by Huffacker and DeBach in 1971. Lu et al discussed the role excessive fertilizer will play in affecting ecological fitness of planthoppers. An increase of nitrogen rate from 100 kg N to 400 kg N can increase BPH populations by 40 folds. A rate of 100 kg N is optimum in most cases. To build sustainable systems that will keep BPH in low densities, a broader perspective incorporating landscape ecology, ecological engineering and population ecology to manage “system resistance” (which includes host plant resistance) will be needed. To achieve this over a large scale will require developing communication strategies with multi stakeholder participation to implement ecological engineering practices. Such approaches will also be needed to build system resilience in order to enhance adaptation strategies and local capacities to reduce local vulnerability and combat climate change. BPH outbreaks have been attributed to the lack of “system resistance” and thus making the crop vulnerable to slight changes in climate and cropping shifts. Rice ecosystems have rich habitat biodiversity that can conserve natural biological control services. From the early 1990s rice farmer’s insecticide use in many countries (except China, Korea and Japan) has steadily reduced as a result of intensive media campaigns, radio and training programs implemented by government. However in the last 5 years, farmers’ insecticide use intensity is gradually increasing. The meta-analysis of farmer surveys conducted from 1992 to 2007 in the Mekong Delta showed that farmers’ insecticide are often prone to external cues. After a campaign or training their insecticide use tended to reduce, but would gradually creep back up subsequently. They attributed this to government pesticide distributions and private sector advertising.

Panel Discussion and Brain storming for solutions

KL Heong introduced a framework of three facets in achieving sustainable management of planthoppers – Ecological management techniques, Ecosystem deteriorating forces and Management and policy facilitation (figure 1). Ecological management techniques to favor ecosystem services, such as IPM, habitat manipulations, use of resistant varieties and ecological engineering are often masked or subdued by Ecosystem deteriorating forces, such as unnecessary prophylactic use of insecticides, cheap pesticides, advertising and promotion motivating insecticide use. In many rice intensification programs, the Management and policy facilitation facet tends to favor the deteriorating forces, such as subsidized pesticides, extension promoting and selling pesticides, lack of pro green policies, lack of incentives to provide environmental services for global benefits. Planthopper outbreaks are signs of ecosystem deterioration and in order to implement sustainable management strategies, there is need to adjust the Management and policy facilitation facet to favor Ecological management techniques. These adjustments might be in pesticide use policies, extension policies, initiating pro green and payment for environmental services (PES) policies. The five panel speakers and the topics they introduced were as follows:

A.	Santi Obien –	Research needs and considerations
B.	Geoff Gurr -	Ecological engineering ideas for planthopper management
C.	J. Xia -	Extension adjustments to promote sustainable management
D.	S. Mohanty -	Social and economic considerations
E.	Peter Kenmore -	Policy adjustments

The Conference participants, facilitated by two external facilitators, were divided into three discussion groups (research, extension and policy) to brainstorm using the framework questions “What to continue, what to stop, what to start and how to start”. The theme question was

> “What structural, policy and research adjustments will be required for sustainable management of rice planthopper problems?”

A summary of the brain storming suggestions is shown in Appendix 2.

Appendix 1. Program

23 to 25 June 2008
Seminar Rooms A, B and C
D.L. Umali Laboratory Bldg.

IRRI
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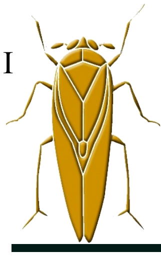


In the 1970s, the brown planthopper (BPH) became a threat to rice intensification programs in Indonesia, Thailand, India, Solomon Islands and the Philippines. IRRI organized the first BPH international conference in 1977 which brought together scientists from all rice producing countries to tackle the problem. Activities triggered by this conference, including IPM, reducing unnecessary insecticide use and breeding tolerant varieties, that contributed to improved management and kept the pest under control for the next 20 years. However in the last 5 years, planthopper problems have intensified in several countries, like China and Vietnam. This might be due of factors such increased fertilizer and pesticide intensities, climate, changes in rice varieties (hybrid rice) and cropping patterns. Growing insecticide resistance especially to imidacloprid, BPMC, fipronil and buprofezin is also a concern. Over the years possibly because of complacency, changes in emphases and shortage of resources there is lack of research, monitoring and comprehensive analyses to understand, model and predict the potential pest developments, leaving a gap in knowledge.

In the last 30 years since the first BPH conference in 1977, scientific approaches in genetics, ecology and pest management have advanced considerably. Classical host plant resistance had been IRRI's main approach to BPH management but this may not suffice, as the pest population structures constantly evolve. Meanwhile several BPH resistance genes (bph 1, 2, 3, 10, 18, 25 etc) and QTLs have been identified by breeders. Ecological research showed that BPH is a secondary pest induced by ecological perturbations. To build sustainable systems that will keep BPH in low densities, a broader perspective incorporating landscape ecology, ecological engineering and population ecology to manage "system resistance" (which includes plant resistance) will be needed. To achieve this over a large scale will require developing communication strategies with multi stakeholder participation. Such approaches will also be needed to build system resilience in order to enhance adaptation strategies and local capacities to combat climate change. BPH outbreaks have been attributed to the lack of "system resistance" and thus making the crop vulnerable to slight changes in climate and cropping shifts. The outbreaks in northern China were partly due to the slight increase in summer temperatures of 2ºC in 2005 and abnormal numbers of south-west typhoons. Similar post-ante analyses of Vietnam's BPH/virus problem may provide important information for developing management options.

Recent research by Japanese entomologists showed that Chinese hybrid rice varieties seem to favor a new problem, the white backed planthopper (WBPH). While hybrid rice adoption is spreading in many Asian countries, research, information and management strategy on this new problem is still lacking. Japanese scientists have also identified sources of induced resistance from WBPH feeding in Japonica varieties.

Rice ecosystems have rich habitat biodiversity that can conserve natural biological control services. From the early 1990s rice farmer's insecticide use in many countries (except China, Korea and Japan) has steadily reduced as a result of intensive media campaigns, radio and training programs implemented by government. However in the last 5 years, farmers' insecticide use intensity is gradually increasing.

The Conference will address the threat of planthopper pests in intensive systems, review ecological concepts bearing on management strategies, progress in developing insect resistance for planthoppers, management of virus diseases transmitted by planthoppers and brainstorm for solutions in adjustments to policy and structures that will favor sustainable management.

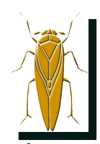
INTERNATIONAL CONFERENCE ON BROWN PLANTHOPPER

Programme

<u>22 June 2008 (Sunday) Arrival of participants</u>

<u>23 June 2008 (Monday) – Day 1</u>

0800	Registration	Secretariat
0830	Opening Session	
	Welcome remarks	*Dr. William Padolina* Acting Director General
0900	*Keynote Address: Science and politics in rice planthopper management in Asia: Prospects for a common language in the future* **Chairperson: Dr. Santiago Obien**	*Dr. Peter Kenmore*
1000	Group photo and coffee/tea break	
1030-1200	*Session 1: Planthopper problems in rice production* **Chairperson: *Professor Jingyuan Xia***	
1030	Global rice market: current situation and lessons from the past	*K. Kajisa*
1100	Planthopper outbreaks in China	*J.A. Cheng*
1130	Recent occurrences of long-distance migratory planthoppers and factors causing the outbreaks in Japan.	*T. Watanabe* *M. Matsumura* *A. Otuka*
1200	Discussions	
1230	Lunch	
1330-1730	*Session 1: Planthopper problems in rice production (continued)* **Chairperson: *Professor Candida Adalla***	
1330	Current status of insecticide resistance in rice planthoppers in Asia.	*M. Matsumura* *H.Takeuchi* *M. Satoh* *S. Sanada-Morimura* *A. Otuka* *T. Watanabe* *D. V. Thanh*
1400	Rice viruses transmitted by brown planthoppers.	*P. Cabauatan* *R. Cabunagan* *I. R. Choi*



1430	Search for cross-boundary migrations between the Southeast Asian population and the East Asian population of rice planthoppers	*A. Otuka* *S.H. Huang* *M. Matsumura* *T. Watanabe*
1500	Prevalence of the whitebacked planthoppers in Chinese hybrid rice and resistance in Chinese japonica rice.	*K. Sogawa* *G. Liu, Q. Qian*
1530	Coffee	
1600	Situation of rice planthoppers in Asia	*J. Catindig* *G. Arida* *S.E. Baehaki* *J.S. Bentur* *L. Q. Cuong* *M. Norowi* *W. Rattanakarn* *W. Sriratanasak* *J. Xia, Z. Lu*
1630	Management of the small brown planthopper *Laodelphax striatellus* and its transmitted rice viral diseases through cultural and chemical approaches.	*Z-R. Zhu* *Y. Zhou, X. Lin* *J. Zhu, H. Wang* *J.A. Cheng* *B.H. Lee*
1700	Discussions	
1730	End of session	
1900	Welcome Dinner at the IRRI Guest House	

24 June 2008, Tuesday

0900	*Keynote Address 2: Prospects for ecological engineering for planthoppers and other arthropod pests in rice* ***Chairperson: Dr K.L.Heong***	*Professor Geoff Gurr* *Charles Sturt*
1000	Coffee/tea break	
1030-1200	*Session 2: Genetics and plant breeding* **Chairperson: Dr. Hei Leung**	
1030	Breeding for planthopper resistance	*D. Brar,* *P. Virk, K.K. Jena*
1100	The genetics of host plant resistance to rice planthoppers	D. Fujita H. Yasui
1130	Variability in planthopper-rice interactions: exploration of three-trophic levels.	*Y.H. Chen* *J. Ferrater* *C. Bernal* *J. Sangha* *A. Romena*

1200	Discussion	
1230	Lunch	
1330-1500	*Session 2: Genetics and plant breeding (continued)* **Chair: Dr Darshan Brar**	
1330	Planthopper genomics: How it can be useful for planthopper management?	*H. Noda*
1400	Resistance-breaking ability and feeding behavior of the brown planthopper, *Nilaparvata lugens*, recently collected in Korea.	*B. Y. Seo* *J. K. Jung* *B. R. Choi* *H. M. Park*
1430	Discussion	
1500	Coffee	
1530-1700	*Session 3: Management of rice planthoppers* **Chairperson: Professor Jiaan Cheng**	
1530	Are planthopper problems due to breakdown in ecosystem services?	*K.L. Heong*
1600	Effects of nitrogen on ecological fitness of planthoppers	*Z. Lu* *X. Yu, K.L. Heong*
1630	Changes in rice farmers' pest management beliefs and practices in Vietnam – A meta analysis of survey data sets (1992 – 2007).	*N.H. Huan,* *M. Escalada,* *K.L. Heong* *H.V. Chien*
1700	Discussion	

25 June 2008 Wednesday

PANEL DISCUSSION AND BRAIN STORMING FOR SOLUTIONS

0830	**Panel Discussion**	
	Introduction	*K.L. Heong*
	What structural, policy and research adjustments will be required for sustainable management of rice planthopper problems?	**Panelists** *P.E. Kenmore* *J. Xia* *S. Obien* *G. Gurr* *S. Mohanty*
1000	Coffee/tea break	
1030 - 1500	Break out groups to brain storm for solutions Groups will be formed during the conference	
1230	Lunch	
1500	Plenary Group reporting	*Group representatives*
1600	Closing Remarks	*J.A. Cheng*

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Appendix 2: Summary of key points discussed by work groups in the International Planthopper Conference – 23-25 June 2008.

RESEARCH

What to continue	What to stop/re evaluate	What to start	How to start	Comments
Monitoring planthopper abundances Monitoring viruses, insecticide resistance Understand basis of HPR/ Improve screening method Understand and apply conservation biological control Understand planthopper evolution Quantify impact of good agricultural practices (GAP) on planthoppers	Re evaluate planthopper resistance screening method eg. Seedbox Stop selection of HPR based on plant traits that only confer anti feeding effects Stop routine evaluations of insecticides Stop developing insecticide mixtures to develop broader spectrum Stop research on use of trangenics for planthopper management Stop just selection of varieties based only on high yields. Stop mixing insecticide promotional activities into research	Research on how to enhance ecosystem services viz. habitat manipulation, landscape ecology Start research in search of "green" or biologically based for pest management Start research on adaptive management responses for pest outbreak management Start research to develop adaptation strategies to climate change effects Develop new protocols to discover new phenotypic materials for HPR Develop measures to quantify ecosystem services. Develop sustainable management strategies by understanding mechanisms of HPR, identify new genes and best timing of each measure Understand ecology and epidemiology of planthoppers and viruses Monitoring og planthoppers, insecticide resistance, virulence Study cost benefits, impact of BPH infestations and farmer practices for BPH management.	Develop proposals for fund raising Develop human capacity in new research approaches Review literature and history of planthopper problems Develop landscape level objectives	Need to quantify not just ecosystem services but their economic impact as well. Policy research not presented. Need to convince government about ecosystem services as alternate items for resource allocation, rather than just pesticides An awareness campaign for policy makers will be a good place to start. Most research items are targeted at the technical level, what about sociological research? These are often more important research if we would like to make significant changes to farmers' practices. Need to do the research on the negative consequences, like causing secondary pests, like BPH in respective countries. IRRI scientists have done these, but similar experiments are needed in respective countries to convince governments.

POLICY and INCENTIVES

What to continue	What to stop	What to start	How to start	Comments
Information flow to farmers, field schools, mass media Restrictions on sale, production and use of banned pesticides Rigorous process for pesticide registration Support for research and extension Conferences and international networking International and national forecasting pest warning system IPM implementation, use of resistant varieties (field resistance), GAP and biological control	Stop providing subsidies to hazardous chemicals Stop excessive fertilizer use Stop corruption Stop heavy pesticide advertising and promotional activities Stop short term decision making Government subsidies for pesticides Advertising and mass information to farmers about outbreaks Import and export of highly toxic pesticides	Multi lateral collaborations (eg in exchange of pest data, germplasm) Awareness for policy makers in support of IPM research Start ecological engineering approaches to pest management Start a mechanism to review policies and make adjustments Start a levy on rice production to support research International collaborations in planthopper ecology, virus epidemiology and ecological engineering to develop sustainable management strategies Re establish Rice IPM Network coordinated by IRRI. Organize international workshops, conferences and establish real time information on planthoppers and leaffolders Implement strict control and regulation of pesticide in imports, advertising and applications Increase funds for research and extension Identify and acknowledge innovative farmers for their efforts in managing planthoppers	A resolution to start multi lateral collaborative programs Policy maker awareness activities, like conferences, policy dialogues, demonstrations, exhibitions. Establish ecological engineering research and demo plots Start process of developing levy Initiate committees to review policies and mechanisms for policy dialogues Set up an international working group on planthoppers Establish national policies on pesticide subsidies. Taxing pesticides Reward farmers for ecological innovations	Levy on rice production may be difficult. Although this can work in developed nations, not sure about in DCs. May be possible to place levies on specific inputs that harm environment, like pesticides. Concerned about using levies to raise funds for research and extension especially in the Philippines where rice is not exported. Raising tax on pesticides may be a good idea, but how can this be implemented? How to start is country dependent. Some are more advance than others. In some less develop nations, there is huge information gaps even at research and policy levels. In this case capacity building might be where we start. HPR is an important component but it must be durable.

EXTENSION

What to continue	What to stop	What to start	How to start	Comments
Farmer participatory research Farmer monitoring of pests and natural enemies Post FFS training activities Use of mass media such as soap operas Strengthening of corporate responsibilities Influencing policies Improving extension policies Strengthening of extension capacities Continue training programs Sustaining monitoring Continue seeking financial support.	Stop sales of banned pesticides Stop misleading pesticide advertisements Stop using farm training schools as channels for pesticide marketing Over dependence on pesticides Stop subsidies Stop overuse of chemical fertilizers Stop wide scale planting of varieties with narrow genetic base ie reduced genetic biodiversity Stop asynchronous planting Stop ignoring farmers' needs.	Raising awareness of IPM Building core groups in communities on critical issues, like climate change and its effects on pests Teaching farmers to do economic analysis Teaching farmers about ecological engineering Initiate new mechanisms for policy dialogue to adjust policies Start a regional network on rice planthoppers Initiate international multilateral projects Start monitoring of pest migrations Start insecticide resistance monitoring Develop a regional strategy for planthopper management	Re vitalize IPM Explore the use ASEAN network Have discussions in the ASEAN ministers' agenda Use CORRA for discussion	IPM has been hijacked in many cases. Reviewing might be useful but it might get into a battle of semantics Important not to dwell in semantics. Get the principles right and go on with them